INSTALLATION AND OPERATION MANUAL

FOM-E1/T1

E1/T1 Fiber Optic Modem

Version 2.0

RAD
data communications
The Access Company

FOM-E1/T1

E1/T1 Fiber Optic Modem

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Installation and Operation Manual

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To facilitate the reuse, recycling and other forms of recovery of waste equipment in protecting the environment, the owner of this RAD product is required to refrain from disposing of this product as unsorted municipal waste at the end of its life cycle. Upon termination of the unit's use, customers should provide for its collection for reuse, recycling or other form of environmentally conscientious disposal.

General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

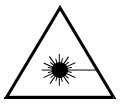
Safety Symbols

Warning

This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

Protective earth: the marked lug or terminal should be connected to the building protective earth bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached.

Please observe the following precautions:

- Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.
- Do not attempt to adjust the laser drive current.
- Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.
- The use of optical devices with the equipment will increase eye hazard.
- Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.

ATTENTION: The laser beam may be invisible!

In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective earth terminal. If an earth lug is provided on the product, it should be connected to the protective earth at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in earthed racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Some products may have panels secured by thumbscrews with a slotted head. These panels may cover hazardous circuits or parts, such as power supplies. These thumbscrews should therefore always be tightened securely with a screwdriver after both initial installation and subsequent access to the panels.

Connecting AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

In cases when the power distribution system is IT type, the switch must disconnect both poles simultaneously.

Connecting DC Mains

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC mains systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

If the DC mains are floating, the switch must disconnect both poles simultaneously.

Connecting Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The earthing and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good earth connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the earth bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching earth ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkströrungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

Declaration of Conformity

Manufacturer's Name:	RAD Data Communications Ltd.
Manufacturer's Address:	24 Raoul Wallenberg St., Tel Aviv 69719, Israel

declares that the product:

Product Name:	FOM-E1/T1

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022:1998 + A1:2000, A2:2003	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 55024:1998 + A1:2001, A2:2003	Information technology equipment – Immunity characteristics- Limits and methods of measurement.
Safety:	EN 60950-1:2001	Information technology equipment – Safety – Part 1: General requirements.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC, the Low Voltage Directive 73/23/EEC and the R&TTE Directive 99/5/EC for wired equipment. The product was tested in a typical configuration.

Tel Aviv, 22 June 2005

Haim Karshen

VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30, 85521 Ottobrunn-Riemerling, Germany

Quick Start Guide

Installation of FOM-E1/T1 should be carried out only by an experienced technician. If you are familiar with FOM-E1/T1, use this quick start guide to set it up for operation.

This guide describes the standalone version of the modem.

Perform the installation procedures for both the local and the remote units.

1. Installing FOM-E1/T1

Configuring FOM-E1/T1

1. Disconnect all the cables connected to FOM-E1/T1.
2. Locate the DIP switch on the FOM-E1/T1 rear panel.
3. Select the electrical interface type (E1 or T1) by setting the E1/T1 section of the rear panel DIP switch to appropriate position.
4. For E1 interface, select its type (balanced or unbalanced) by setting the BAL/UNBAL section of the rear panel DIP switch to appropriate position.

Table below provides details on the functions of the DIP switch, and its default settings.

Switch	Function	Possible Settings (default setting in bold)
SW1, LOOP ENABLE	Enables or disables LLB or RLB activation	ON – LLB or RLB is activated **OFF** – LLB or RLB is not activated
SW2, RLB/LLB	Selects local loopback (LLB) or remote loopback (RLB) to be activated from FOM-E1/T1	ON – RLB is selected **OFF** – LLB is selected
SW3, E1/T1	Selects electrical interface type (E1 or T1)	**ON** – E1 OFF – T1
SW4, BAL/UNBAL	Selects the E1 interface type (balanced or unbalanced)	**ON** – Balanced E1 (120Ω) OFF – Unbalanced E1 (75Ω)
SW5, AIS	When a major alarm is detected, AIS is transmitted to the electrical or optical interface.	**ON** – Transmit AIS OFF – Do not transmit AIS

Connecting the Cables

➤ To connect cables:

1. Connect the E1/T1 electrical interface.
2. Connect the fiber optic interface.
3. Connect the power cable (first to the modem, then to the mains).

   Operation starts when the power is applied to the rear panel power connector.

2. Operating FOM-E1/T1

1. Check that SW1 of the DIP switch is set to OFF.
2. Verify LED status. All the LED indicators should be OFF, except for the PWR indicator.
3. If there is an indication of a malfunction or fault, run a diagnostic test.

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Chapter 1

Introduction

1.1 Overview

This manual provides information on the technical characteristics, installation, and operation of the FOM-E1/T1 fiber optic modem as a standalone unit, and as FOM-E1/T1/R rack-mount card for the ASM-MN-214 modem rack.

FOM-E1/T1 is a fiber optic modem for transmission of E1 (2.048 Mbps) or T1 (1.544 Mbps) over multimode or single-mode fiber optic media. The communication equipment is connected to FOM-E1/T1 according to the ITU G.703 standard. The modem is designed to operate with several types of fiber optic cables and connectors. The electrical signals are connected through an RJ-45 connector or BNC connectors. LED indicators on the front panel show the operational status of the modem. Alarms indicating faults in modem operation are relayed via dedicated port. Local and remote loopback tests are available for diagnostics.

Product Options

The following versions of the FOM-E1/T1 modem are available:

- FOM-E1/T1 – standalone unit
- FOM-E1/T1/R – a plug-in card for installation in the ASM-MN-214, 19-inch modem rack, holding up to 14 cards (see C*hapter 5* for the FOM-E1/T1/R description).

Application

In the application illustrated, each FOM-E1/T1 receives E1 or T1 signals that are equalized to overcome electrical link distortion. FOM-E1/T1 then converts the E1 or T1 signals into an optical signal.

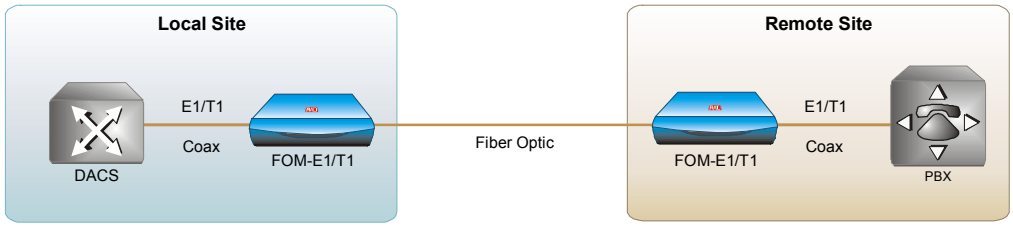

Figure 1-1 FOM-E1/T1 Application

Features

Fiber Optic Interface

Table 1-1 provides information on the characteristics of the fiber optic interface types supported by FOM-E1/T1 and FOM-E1/T1/R, including the maximum range of a typical fiber optic cable. The maximum range values given assume a margin of 3 dB.

Table 1-1. Fiber Optic Interface Types

Wavelength	Fiber Type	Transmitter Type	Typical Power	Receiver Sensitivity	Connector	Typical Max. Range	
[nm]	[µm]		[dBm]	[dBm]		[km]	[mi]
850	62.5/125 multimode	VCSEL/LED VCSEL	-18 (FOM-E1/T1/R) -7 (FOM-E1/T1)	-35 (FOM-E1/T1/R) -32 (FOM-E1/T1)	ST, SC, FC	4.8 6.7	3.0 4.2
1310*	62.5/125 multimode	LED	-18	-31	ST, SC	9.3	5.7
1310	9/125 single mode	Laser	-12	-40	ST, SC, FC	50.0	31.0
1310*	9/125 single mode	Laser (long haul)	-2	-40	ST, SC, FC	70.0	43.4
1550	9/125 single mode	Laser	-12	-38	ST, SC, FC	92.0	57.0
1550*	9/125 single mode	Laser (long haul)	-1	-40	ST, SC, FC	144.0	89.4
1310/1550*	9/125 single mode	Laser (WDM), SF1	-12	-34	SC	38.0	23.6
1550/1310*	9/125 single mode	Laser (WDM), SF2	-12	-34	SC	38.0	23.6
1310*	9/125 single mode	Laser (single fiber), SF3	-12	-27	SC	20.0	12.4

Note *Fiber optic interfaces that are marked with an asterisk (*) are for the FOM-E1/T1 standalone version only.*

Typical attenuation for the fiber optic interface units is as follows:

- 3.5 dB/km for 62.5/125 µm multimode fiber sat 850 nm
- 1.5 dB/km for 62.5/125 µm multimode fiber sat 1310 nm
- 0.5 dB/km for 9/125 µm single mode at 1310 nm
- 0.25 dB/km for 9/125 µm single mode at 1550 nm

E1/T1 Interface

- The electrical interface meets requirements of ITU G.703 standard for E1 and T1.
- FOM-E1/T1 supports both balanced and unbalanced interfaces.

When FOM-E1/T1 detects electrical interface levels below G.703 electrical levels, the modem transmits an "All 1 signal" (AIS) to the optical interface.

Test and Diagnostics Capabilities

- FOM-E1/T1 supports local and remote loopback activation.
- FOM-E1/T1 features a dry contact alarm port (DB-9) for attaching an external alert device.
- When an AIS is detected at the optical or electrical interface, the modem transparently converts the signal and alerts the user via front panel LEDs.

1.2 Physical Description

FOM-E1/T1 is a compact unit, intended for installation on desktops or shelves. FOM-E1/T1 can be installed in a 19-inch rack using an optional rack-mount adapter kit. *Figure* 1-2 shows FOM-E1/T1.

Figure 1-2 FOM-E1/T1 3D View

The front panel LEDs indicate the modem status. Front panel indicators and controls are described in C*hapter 3.*

The rear panel connectors and internal jumpers are described in C*hapter 2*.

1.3 Functional Description

This section describes the functional circuitry of the FOM-E1/T1 fiber optic modem. FOM-E1/T1 is used for transmission of E1 (2.048 Mbps) and T1 (1.544 Mbps) over multimode or single-mode fiber optic media. The unit is transparent to framing and can transmit data using any framing pattern with HDB3 or B8ZS coded signals.

Figure 1-3 illustrates the FOM-E1/T1 block diagram.

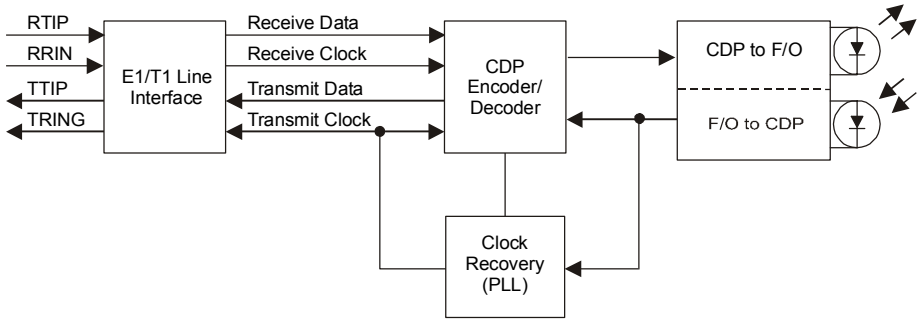

Figure 1-3 FOM-E1/T1 Block Diagram

FOM-E1/T1 comprises the following signal processing stages:

- Signal conversion
- Data/clock recovery
- Data transfer.

Signal Conversion

Electrical signals are converted into an optical signal using an infrared light-emitting diode or laser transmitter. At the opposite end of the fiber, the optical signal is converted back into an electrical signal and amplified to the required level.

Data/Clock Recovery

A Phase Locked Loop (PLL) circuit recovers data and clocking from the signal. FOM-E1/T1 provides internal selection for the E1/T1 electrical interfaces.

Data Transfer

The optical signal is linked to the fiber-optic media and transmitted over the optical link to the remote unit. The remote unit receives the optical signal into a high sensitivity pre-amplifier and an AGC (Automatic Gain Control) circuit. The output of the receiver is applied to the clock recovery circuit and the data regeneration circuit, which in turn apply it to the electrical interface driving circuit.

1.4 Technical Specifications

E1/T1 Interface	*Transmission Rates*	E1: 2.048 Mbps T1: 1.544 Mbps
	Interface	User-selectable: • E1: 120Ω balanced or 75Ω unbalanced • T1: 100Ω balanced
	Line Code	E1: HDB3, B8ZS or AMI
	Connectors	Balanced: RJ-45 Unbalanced: two BNC coax
Optical Interface	*Technical Specifications*	See *Table* 1-1
Alarm Relay	*Type*	Dry contacts
	Operation	Normally Open and Normally Closed, using different pins
	Maximum Ratings	1A, 60 VDC, 30 VAC
	Connector	9-pin, D-type, female
Indicators	*POWER*	ON – The unit is powered up
	LLB	ON – The unit is in local loopback mode
	RLB	ON – The unit is in remote loopback mode
	ELEC LOSS	ON – The electrical interface input is below G.703 electrical levels
	ELEC AIS	ON – An "All 1s" string is received at the electrical interface
	OPTICAL LOSS	ON – Bit error rate of the received signal from the optical interface is 10^{-6} or worse
	OPTICAL AIS	ON – An "All 1s" string is received at the optical interface
Physical	*Height*	43.7 mm (1.7 in)
	Width	240 mm (9.4 in)
	Depth	170.5 mm (6.7 in)
	Weight	0.5 kg (1.1 lb)

Power	*Wide-Range Version*	100 to 240 VAC, 50 to 60 Hz 8 VA or 48 VDC (48 to 60 VDC) 3W
	DC Version	24 VDC 4W
	Fuses	FOM-E1/T1/R: 1A 250V and 50 mA 250V
Environment	*Temperature*	-5°–55°C (23°–131°F)
	Humidity	Up to 90%, non–condensing

Chapter 2
Installation and Setup

2.1 Introduction

This chapter describes installation and setup procedures for the standalone FOM-E1/T1 modem.

FOM-E1/T1 is delivered completely assembled. It is designed for tabletop installation.

After installing the unit, refer to *Chapter 3* to assure normal operation.

In case a problem is encountered, refer to *Chapter 4* for test instructions.

Note *Before installing the product, review* Handling Energized Products *at the beginning of the manual.*

2.2 Site Requirements and Prerequisites

Before installation, review *Handling Energized Products* in the front matter of this manual.

AC-powered FOM-E1/T1 units should be installed within 1.5m (5 ft) of an easily-accessible grounded AC outlet capable of furnishing the voltage in accordance with FOM-E1/T1 nominal supply voltage.

DC-powered FOM-E1/T1 units require a 24 VDC or -48 VDC power source, which must be adequately isolated from the main supply.

Allow at least 90 cm (36 in) of frontal clearance for operating and maintenance accessibility. Allow at least 10 cm (4 in) clearance at the rear of the unit for signal lines and interface cables.

The ambient operating temperature of FOM-E1/T1 is 0° to 50°C (32° to 122°F) at relative humidity of 90%, non-condensing.

2.3 Package Contents

The package of the FOM-E1/T1 modem includes:

- One FOM-E1/T1 unit or FOM-E1/T1/R card
- Technical documentation CD

- Power cord
- DC adapter connector (for FOM-E1/T1 with 48 VDC option)

2.4 Equipment Needed

FOM-E1/T1 is a standalone device intended for tabletop or bench installation. It is delivered completely assembled. There is no provision for bolting the unit on the tabletop.

The only mechanical installation procedure that may be necessary is optional installation in a 19-inch rack or mounting on the wall:

- Use RM-33-2 for mounting one or two units in a 19-inch rack
- Use the K-33 drilling template included in this manual for mounting FOM-E1/T1 on the wall.

2.5 Setting the Jumpers and Switches

Figure 2-1 illustrates the rear panel DIP switch. *Table 2-1* provides details on the functions of the DIP switch, and its default settings.

➤ **To configure FOM-E1/T1:**

1. Disconnect all the cables connected to FOM-E1/T1.
2. Select the electrical interface type (E1 or T1) by setting the E1/T1 section of the rear panel DIP switch to appropriate position.
3. For E1 interface, select its type (balanced or unbalanced) by setting the BAL/UNBAL section of the rear panel DIP switch to appropriate position.

Proceed with the line, DTE and power connections as described below.

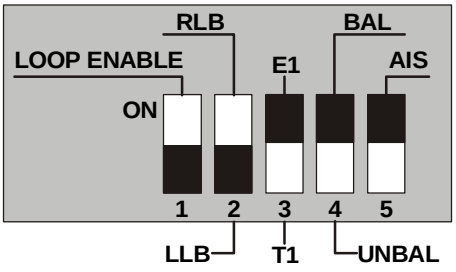

Figure 2-1 Rear Panel DIP Switch

Table 2-1 FOM-E1/T1 DIP Switch Settings

Jumper/Switch	Function	Possible Settings (factory settings shown in bold)
SW1, LOOP ENABLE	Enables or disables LLB or RLB activation	ON – LLB or RLB is activated **OFF** – LLB or RLB is not activated
SW2, RLB/LLB	Selects local loopback (LLB) or remote loopback (RLB) to be activated from FOM-E1/T1	ON – RLB is selected **OFF** – LLB is selected
SW3, E1/T1	Selects electrical interface type (E1 or T1)	**ON** – E1 OFF – T1
SW4, BAL/UNBAL	Selects the E1 interface type (balanced or unbalanced)	**ON** – Balanced E1 (120Ω) OFF – Unbalanced E1 (75Ω)
SW5, AIS	When a major alarm is detected, AIS is transmitted to the electrical or optical interface.	**ON** – Transmit AIS OFF – Do not transmit AIS

2.6 Connecting the Interfaces

Figure 2-2 illustrates a rear panel of a typical FOM-E1/T1 unit.

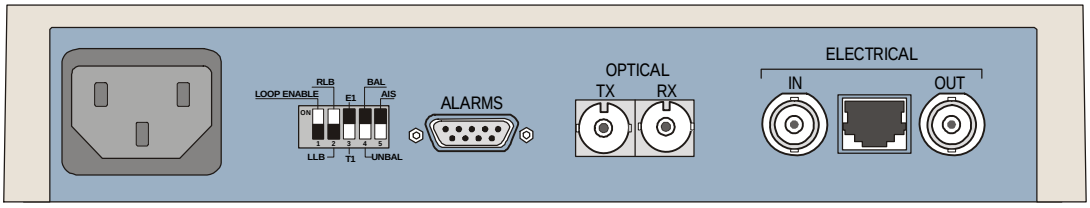

Figure 2-2 FOM-E1/T1 Rear Panel

Connecting the Fiber Optic Interface

Two fiber optic ST, SC, or FC connectors are located on the rear panel and marked OPTICAL TX and OPTICAL RX.

➤ **To connect the fiber optic cables:**

1. Remove the protective caps from the connectors and store them in a safe place for later use.
2. Connect the transmit fiber to the connector marked TX and the receive fiber to the connector marked RX.
3. At the remote unit connect the transmit fiber to RX and the receive fiber to TX.

Connecting the E1/T1 Interface

The rear-panel E1/T1 connector provides interface for data input/output, clock reference, and control signal exchange between FOM-E1/T1 and E1/T1 equipment.

A balanced E1/T1 interface terminates in an RJ-45 connector (see *Appendix A* for the connector pinout).

An unbalanced E1 interface terminates in two coaxial BNC connectors, designated as IN and OUT. IN refers to the FOM-E1/T1 input signal. OUT refers to a signal transmitted from FOM-E1/T1 to the attached equipment.

Connecting the Alarm Relay

Connect a cable with a 9-pin, D-type, male connector to the connector marked ALARMS (see *Appendix A* for the connector pinout).

2.7 Connecting to Power

Warning

Before connecting this unit to a power outlet and connecting or disconnecting any other cable, the protective earth terminals of this unit must be connected to the protective ground conductor of the mains (AC or DC) power cord. If you are using an extension cord (power cable) make sure it is grounded as well.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting of the protective earth terminal can make this unit dangerous. Intentional interruption is prohibited.

Connecting AC Power

AC power is supplied to the FOM-E1/T1 modem through a standard 3-prong connector.

Connect AC power through the 1.5m (5 ft) standard power cable terminated by a standard 3-prong connector. A cable is provided with the unit.

➤ **To connect AC power:**

1. Connect the power cable to the power connector on the FOM-E1/T1 rear panel.
2. Connect the power cable to the mains outlet.

   The unit powers on automatically when connected to the mains.

Connecting DC Power

A special IEC 60320 adapter for connection to -48/-60 VDC power is supplied with the unit. 24 VDC FOM-E1/T1 units have a terminal block DC inlet and an adapter supplied with the unit.

➤ **To connect DC power:**

- Refer to the DC power supply connection supplements for instructions how to wire the DC adapters, and to the *Handling Energized Products* section.

Chapter 3

Operation

This chapter contains the following information for the FOM-E1/T1 standalone modem:

- FOM-E1/T1 front-panel indicators and controls
- Operating procedures (turn-on, front-panel indications, performance monitoring and turn-off)

Note *Complete and check the installation procedures in* Chapter 2 *before operating FOM-E1/T1.*

3.1 Turning FOM-E1/T1 On

FOM-E1/T1 starts operating as soon as it is connected to the power source. The PWR LED turns ON and remains lit as long as the unit is connected to the mains.

3.2 Controls and Indicators

During normal operation all indicators should be OFF, except for the PWR indicator.

Note *Some of LEDs may turn on upon the FOM-E1/T1 power-up, indicating that other communication equipment is not functioning properly.*

Figure 3-1 shows the FOM-E1/T1 front panel. *Table 3-1* lists the FOM-E1/T1 controls and indicators.

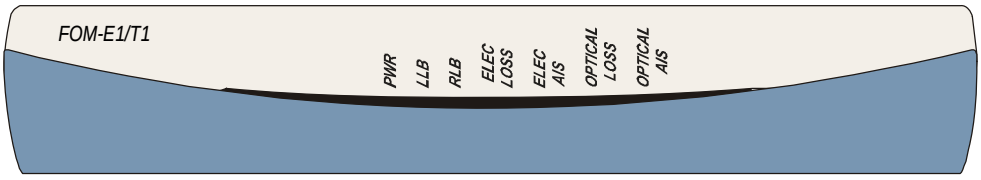

Figure 3-1. FOM-E1/T1 Front Panel

Table 3-1. FOM-E1/T1 Front Panel Controls and Indicators

Name	LED Color	Function
PWR	Green	ON – FOM-E1/T1 is powered up
LLB	Yellow	ON – A local loopback is active
RLB	Yellow	ON – A remote loopback is active
ELEC LOSS	Red	ON – E1/T1 electrical input is below G.703 level
ELEC AIS	Yellow	ON – E1/T1 electrical interface received "All 1s" string
OPTICAL LOSS	Red	ON – Bit error rate of the signal received from the optical interface is 10^{-6} or worse
OPTICAL AIS	Yellow	ON – Fiber optic interface received "All 1s" string

3.3 Turning Off

To turn FOM-E1/T1 off, disconnect the power cord from the mains.

Chapter 4

Troubleshooting and Diagnostics

This chapter describes the following FOM-E1/T1 diagnostic functions:

- Front panel LED indicators
- Alarm relays
- Diagnostic loopbacks.

The chapter also provides tips on troubleshooting and frequently asked questions.

4.1 Detecting Errors

Front Panel LEDs

The front panel LED indicators indicate the status of the FOM-E1/T1. For a description of LED indicators and their functions, see *Chapter 3*.

Alarm Relays

FOM-E1/T1 has dry contact alarm relays. The following fault conditions trigger the major and minor alarm relays:

- A major alarm is initiated when E1/T1 electrical input drops below G.703 electrical levels, or the bit error rate at the fiber optic interface is higher than 10^{-6}.
- A minor alarms occurs when an Alarm Indication Signal (AIS) is received at the E1/T1 electrical or fiber optic interfaces.

For information on the DB-9 connector pins used for the alarm relays, see *Appendix A*, table A-2.

Note *When connecting an external alarm-monitoring device, do not exceed the maximum rating of the alarm relay contacts (1A, 60 VDC, 30 VAC).*

4.2 Troubleshooting

Table 4-1 gives details on troubleshooting. Perform the actions listed under *Corrective Measures* in the order given in the table until the problem is corrected.

Table 4-1. Troubleshooting Chart

Symptom	Probable Cause(s)	Corrective Measures
PWR LED is OFF	No AC power	Verify that the power outlet is providing the required power. Ensure that both ends of the AC power cord are connected properly.
ELECTRICAL LOW LED is ON	E1/T1 cable is disconnected from the RJ-45 ELECTRICAL connector	Ensure that the E1/T1 cable is connected properly to the RJ-45 connector.
	One of coaxial cables is disconnected or defective	Ensure that both ends of the coaxial cables are connected properly and that the cables operate properly.
	The attached equipment outputs are not according to G.703 electrical levels	Check that the output levels of equipment attached to FOM-E1/T1 comply with G.703 electrical levels.
	The SW3, SW4 switches are not set correctly	Verify that the SW3, SW4 switch positions correspond to the E1/T1 interface type.
ELECTRICAL AIS LED is ON	The attached equipment is transmitting “All 1s" string	Ensure that the equipment attached to the FOM-E1/T1 is transmitting real data (not “All 1s").
OPTICAL LOSS LED is ON	No optical connection	Ensure that both transmit and receive fiber connections on the local and remote units are connected properly.
	Optical budget is too low	Measure the optical loss over the fiber link and verify that it meets the product specifications.
OPTICAL AIS LED is ON	The equipment attached to the remote unit is transmitting “All 1s" string	Check the transmission of the remote attached equipment.
	The remote unit detected Electrical Low alert	Check the remote unit and the remote attached equipment for possible fault.

4.3 Testing FOM-E1/T1

Local Loopback (LLB)

FOM-E1/T1 supports local loopbacks that test the electrical interface of the local unit, the performance of the E1/T1, and equipment attached to the interface.

Data received at the E1/T1 electrical interface is returned (looped back) to the attached equipment. Also, if the AIS switch is set ON, the AIS is sent to the remote unit (see *Figure 4-1*).

Note *FOM-E1/T1/R does not transmit AIS to the remote unit when the LLB is initiated.*

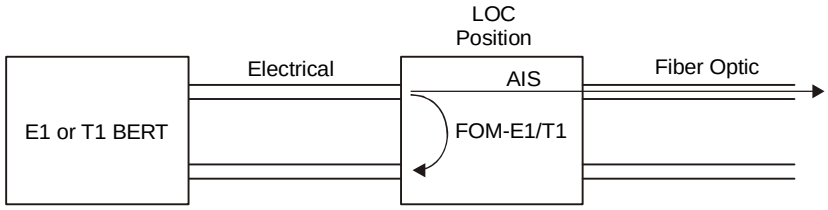

Figure 4-1. Local Analog Loopback

➤ **To activate a local loopback:**

1. Set SW2 (RLB/LLB) of the rear panel DIP switch to the OFF (LLB) position.
2. Set SW1 of the rear panel DIP switch to the ON (LOOP ENABLE) position.

   The TEST LOC indicator lights up and remains lit as long as the local loopback is active.

Remote Loopback (RLB)

FOM-E1/T1 supports remote loopbacks that test the performance of the local unit's E1/T1 electrical and optical interfaces and the remote unit's optical interface.

The data received at the optical interface of the remote unit is looped back to the local unit. In addition, if the switch AIS is set to on, the AIS is sent to the remote electrical interface (see *Figure 4-2*).

Note *FOM-E1/T1/R does not transmit AIS to the electrical interface, when the RLB is initiated.*

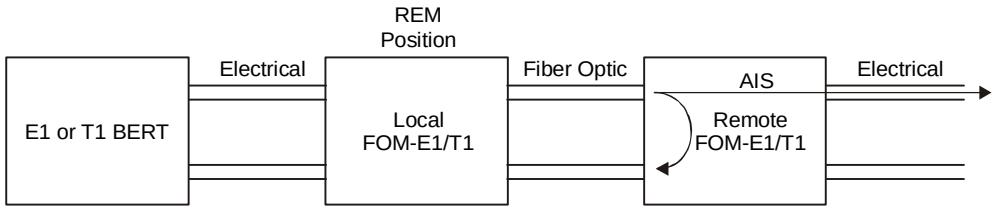

Figure 4-2. Remote Loopback

➤ **To activate remote loopback:**

1. Set SW2 (RLB/LLB) of the rear panel DIP switch to the ON (RLB) position.
2. Set SW1 of the rear panel DIP switch to the ON (LOOP ENABLE) position.

   The TEST REM indicator lights up and remains lit as long as the remote loopback is active.

4.4 Frequently Asked Questions

Q: Does FOM-E1/T1 operate opposite FOM-40?

A: No. The fiber optic interfaces of these modems are not compatible.

Q: Can I connect FOM-E1/T1 with a balanced interface to FOM-E1/T1 with an unbalanced interface?

A: Yes

Q: What is the maximum distance between FOM-E1/T1 and end equipment (E1 link)?

A: The FOM-E1/T1 output conforms to the G.703 standard: the coding is bipolar ±3V with the maximum attenuation of -12 dB for E1 and -7 dB for T1.

4.5 Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide. This information can be found at www.rad.com (offices – About RAD › Worldwide Offices; distributors – Where to Buy › End Users).

Chapter 5

FOM-E1/T1/R Card Version

This chapter describes the card cage version of FOM-E1/T1 and discusses the following topics:

- ASM-MN-214 card cage
- FOM-E1/T1/R plug-in card for the ASM-MN-214 cage
- Cage and card power supply
- Installation of cage and card.

5.1 ASM-MN-214 Card Cage

The ASM-MN-214 card cage contains one or two power supplies and up to 14 plug-in cards. The card types can be FOM-E1/T1/R or other RAD rack version modems or converters in any combination of up to 14 plug-in cards.

For each of the 14 cards, the rear panel (see *Figure 5-1*) contains a male connector for the terminal block and a DB-25 connector. A protection cover protects the terminal block connectors.

For the balanced E1/T1 interface, the terminal block contains screws for connecting the transmit and receive pairs and ground. The transmit pair is connected to the terminals marked XMT, the receive pair connects to the terminals marked RCV, and the fifth screw is a terminal for optional ground connection. When operating FOM-E1/T1/R with an unbalanced E1 interface, use adapter CIA/TB-BNC/214 that converts the terminal block connector into two coaxial BNC connectors.

The 25-pin D-type female connector serves as an alarm relay port (see *Appendix A* for the connector pinout).

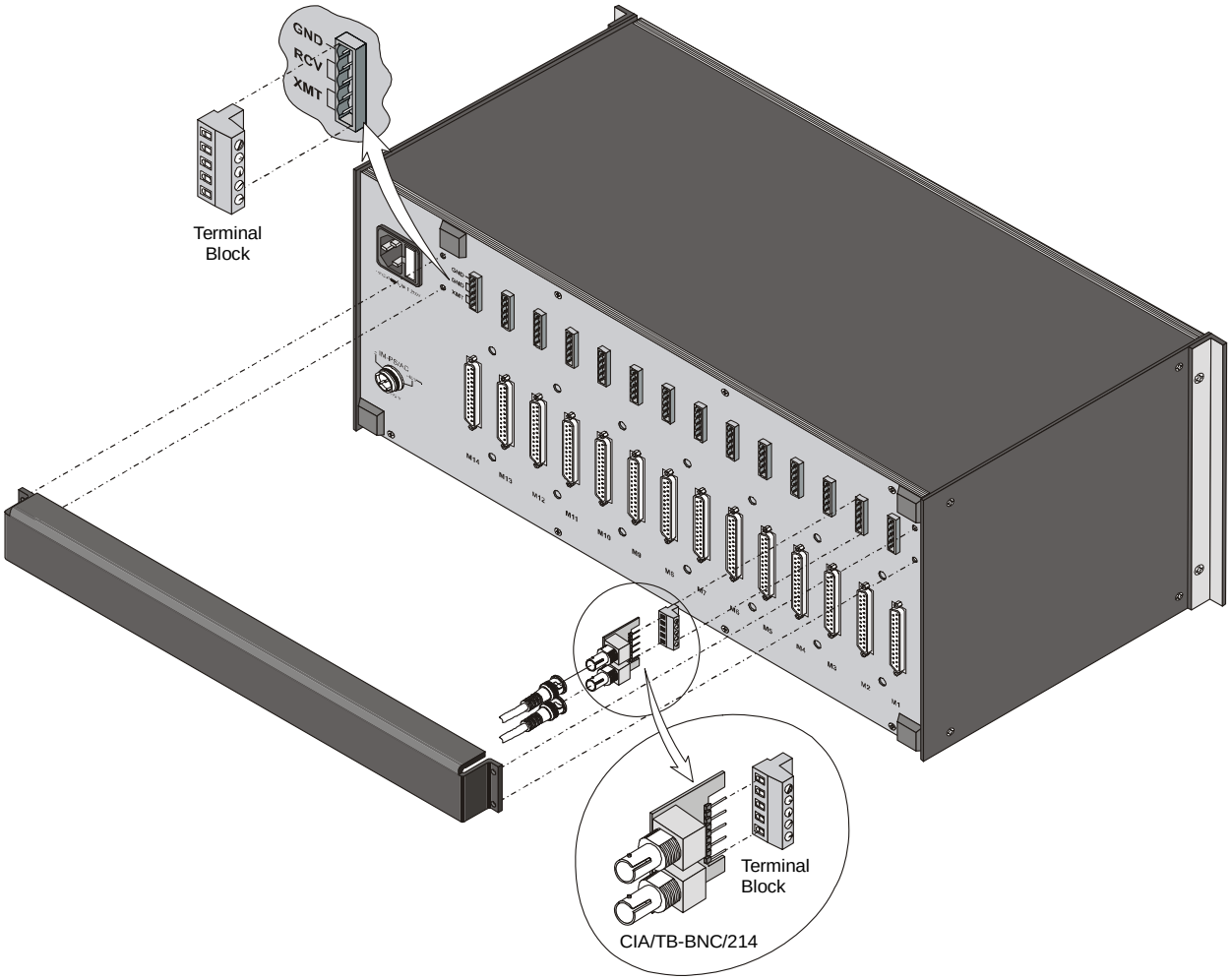

Figure 5-1 ASM-MN-214 Rear Panel

5.2 Power Supply

The FOM-E1/T1/R card is powered from the ASM-MN-214 power supply through the chassis. Each FOM-E1/T1/R card has two fuses that protect the entire system against power failure due to a short circuit in one card (see *Figure 5-4*). The ratings of the fuses are 1A, 250V and 50 mA, 250V.

The ASM-MN-214 card cage can accept both AC and DC power supplies. LED indicators located on the ASM-MN-214 front panel (see *Figure 5-2*) show activity when the power supply is connected to the mains plug. The power supply supports the full card cage with any combination of cards.

AC Supply

The AC power supply of the ASM-MN-214 is 100, 115, or 230 VAC, ±10%, 47 to 63 Hz.

DC Supply

The DC power supply is -48 VDC (-36 to -72 VDC) or 24 VDC (18 to 32 VDC). It uses a DC/DC converter module to provide the power required for the cards.

Power Supply Redundancy

Optional power supply redundancy provides two separate power supplies that operate together and share the load of the whole card cage. If either of the power supplies fails, the other one will continue to supply full power to the card cage.

Two LED indicators show activity of each power supply. They both light when mains power is provided.

Note *It is possible to combine AC and DC power supplies in the same cage.*

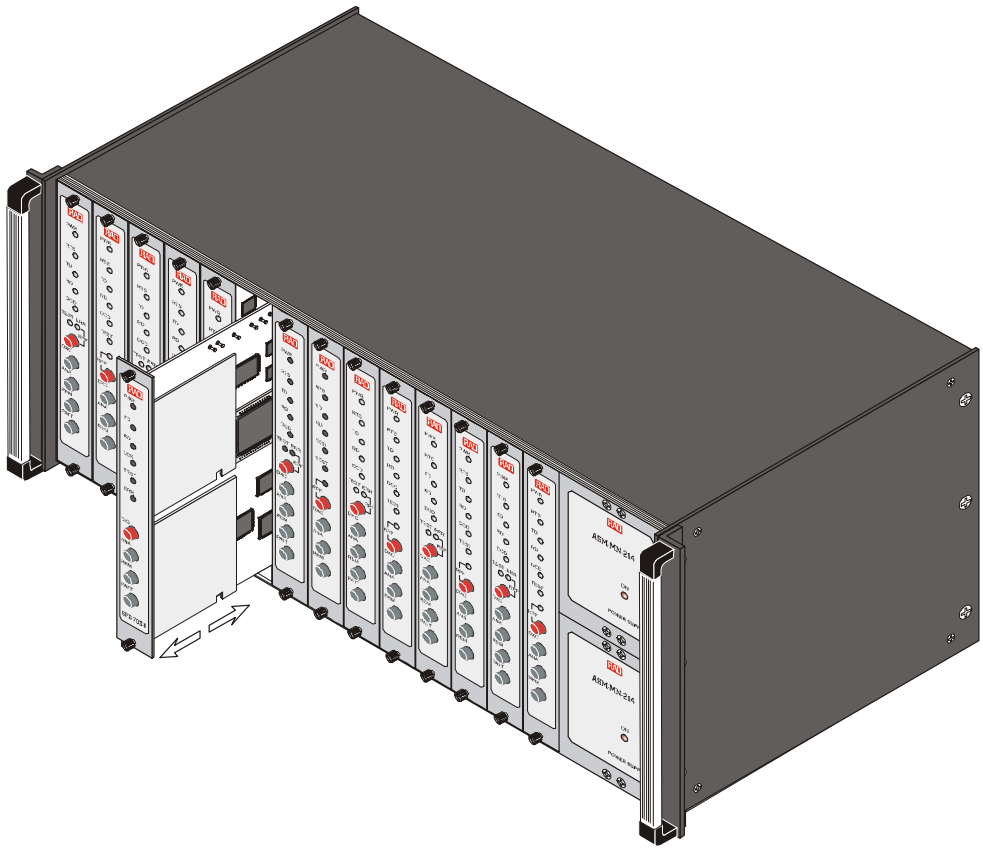

Figure 5-2 ASM-MN-214 Front Panel

5.3 FOM-E1/T1/R Front Panel

Figure 5-3 shows the FOM-E1/T1/R card front panel. The front panel of FOM-E1/T1/R includes fiber optic connectors, loopback initiation switch, and LED indicators. The front panel LEDs of the card version are functionality identical to those in the standalone device. For information on the LED indicators, see *Front Panel Controls and Indicators* in *Chapter 3.*

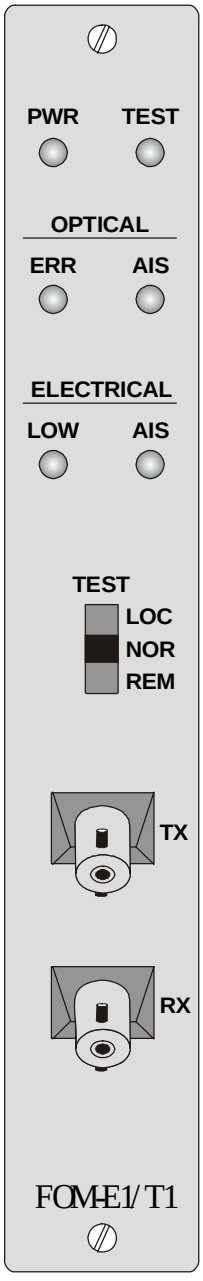

Figure 5-3 FOM-E1/T1/R Front Panel

5.4 Installing the FOM-E1/T1/R Card

Setting the Jumpers and Switches

The FOM-E1/T1/R internal jumpers and switches are described in *Table 5-1*.

Figure 5-4 illustrates the FOM-E1/T1/R PCB layout.

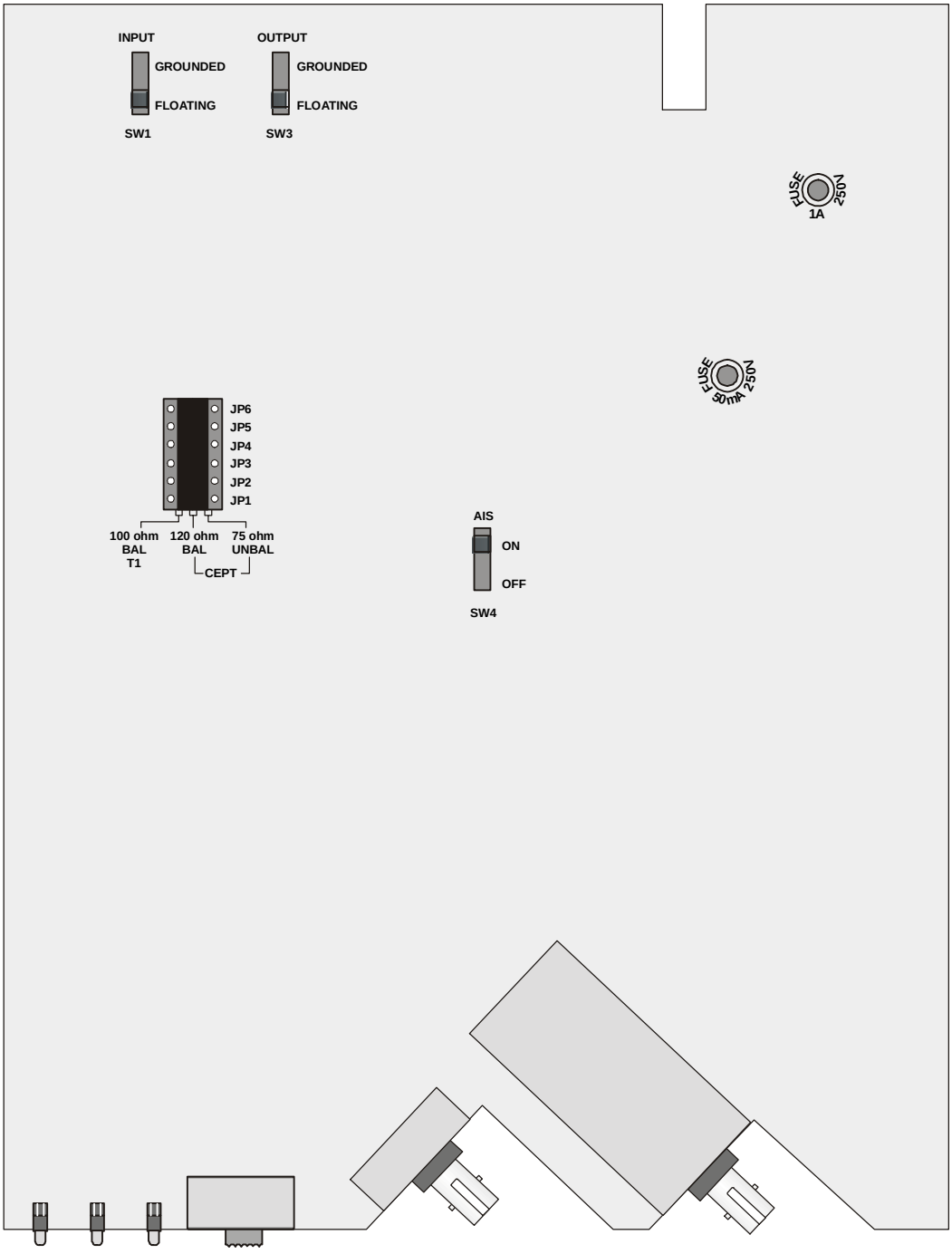

Figure 5-4 FOM-E1/T1/R PCB Layout

Table 5-1. FOM-E1/T1/R Internal Jumpers and Switches

Jumper/Switch	Function	Possible Settings (factory setting in bold)
SW4, AIS	When a major alarm is detected, AIS is transmitted to either the electrical or optical interface.	**ON** – Transmit AIS OFF – Do not transmit AIS
SW1, INPUT Ground SW3, OUTPUT Ground	Controls connection of the BNC shield to the chassis ground	CONNECTED – BNC shield is connected to the chassis ground (for E1 unbalanced) **FLOATING** – BNC shield is disconnected from the chassis ground (for E1/T1 balanced)
JP1, JP2, JP3, JP4, JP5, JP6	Selects the E1/T1 electrical interface	100 ohm BAL T1 – T1 100Ω balanced **120 ohm BAL CEPT** – E1 120Ω balanced 75 ohm UNBAL CEPT – E1 75Ω unbalanced

Installing FOM-E1/T1/R in the ASM-MN-214 Card Cage

➤ **To install FOM-E1/T1/R into ASM-MN-214:**

1. Install the ASM-MN-214 card cage in the 19-inch rack.
2. Insert the FOM-E1/T1/R card into one of the ASM-MN-214 slots.
3. Push the card into the cage until it is fully inserted into the edge connector inside the rack.
4. Tighten the screws on the front panel of the card.

Connecting the Interfaces

FOM-E1/T1/R uses the ports on the ASM-MN-214 rear panel terminal block for E1/T1 connections. The 25-pin D-type female connector serves as an alarm relay port.

Balanced E1/T1

The two Tx screws on the terminal block serve as the E1/T1 electrical signal outputs of the modem. The Rx screws on the terminal block serve as the electrical signal inputs to the modem.

Unbalanced E1

When operating FOM-E1/T1/R with an unbalanced E1 interface, use adapter CIA/TB-BNC/214 to convert the terminal block connector into two coaxial BNC connectors.

Fiber Optic

The ST, SC, or FC fiber optic connectors are located on the front panel of the modem card.

Alarm Relay

The ASM-MN-214 DB-25 connector serves as an alarm relay port (see *Appendix A* for the connector pinout).

Appendix A
Pinouts

A.1 Standalone FOM-E1/T1

Balanced RJ-45 Connector

A balanced E1/T1 interface terminates in an RJ-45 connector. *Table A-1* describes the RJ-45 connector pinout.

Table A-1. RJ-45 Connector Pinout

Pin	Designation	Function
1	Send Data (TTIP)	Transmit Data, A-wire (FOM-E1/T1 output)
2	Send Data (TRING)	Transmit Data, B-wire (FOM-E1/T1 output)
4	Receive Path (RTIP)	Receive Data, A-wire (FOM-E1/T1 input)
5	Receive Path (RRING)	Receive Data, B-wire (FOM-E1/T1 input)

DB-9 Alarm Relay Connector

The 9-pin D-type female connector on the rear panel connects to the major and minor alarm relay. *Table A-2* describes the DB-9 connector pinout.

Table A-2. DB-9 Connector Pinout

Pin	Contact	Alarm Type
2, 6	Normally Closed	Minor
1, 6	Normally Open	
5, 9	Normally Closed	Major
4, 9	Normally Open	

The relay positions are shown in the non-energized (alarm active) state.

A.2 FOM-E1/T1 /R Modem Card

The 25-pin D-type female connector on the rear panel of the ASM-MN-214 modem rack serves as an alarm relay port. *Table A-3* lists the functions of the DB-25 pins.

Table A-3 ASM-MN-214, DB-25 Pin Assignment

Pin	Contact	Alarm Type
10, 22	Normally Closed	Minor
10, 21	Normally Open	
13, 25	Normally Closed	Major
13, 24	Normally Open	

The relay positions are shown in the non-energized (alarm active) state.

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Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: FOM-E1/T1 version 2.0

Publication Number: 284-200-09/08

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❒	❒	❒	❒	❒
Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

What did you like about the manual?

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Error Report

Type of error(s) or problem(s):

- ❒ Incompatibility with product
- ❒ Difficulty in understanding text
- ❒ Regulatory information (Safety, Compliance, Warnings, etc.)
- ❒ Difficulty in finding needed information
- ❒ Missing information
- ❒ Illogical flow of information
- ❒ Style (spelling, grammar, references, etc.)
- ❒ Appearance
- ❒ Other _____

Please list the exact page numbers with the error(s), detail the errors you found (information missing, unclear or inadequately explained, etc.) and attach the page to your fax, if necessary.

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Please add any comments or suggestions you may have.

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